RUTHERFORD BULLETIN

25 February 1980 No.4

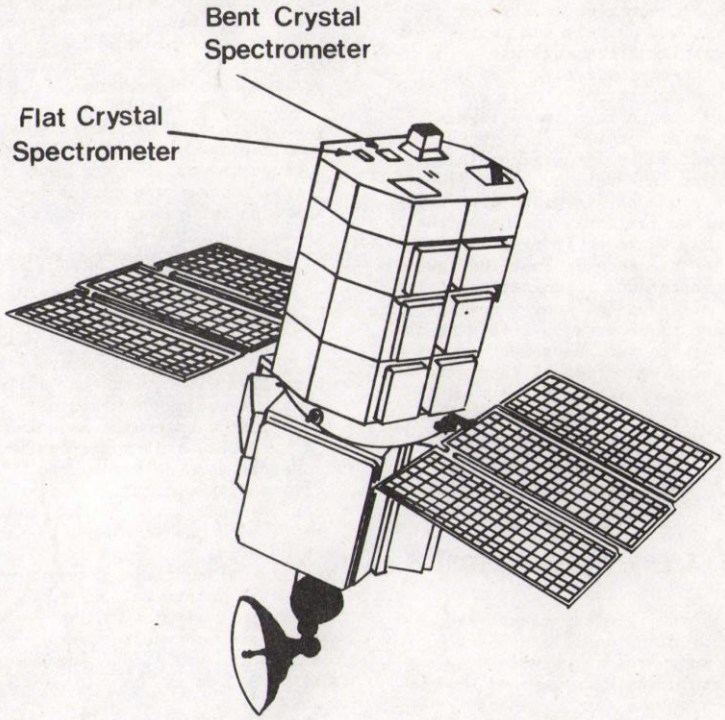
Valentine's Day Launch of SMM

Five years work by the Appleton Laboratory at Culham were brought to fruition on February 14th with the launch of the NASA Solar Maximum Mission satellite. The launch into the 310 mile high orbit took place at 15.57 GMT from the Kennedy Space Center at Cape Canaveral by means of a Delta 3910 rocket. Delta Number 151. The Solar Maximum Mission Satellite (SMM) was launched to coincide with the 1980 peak in the solar 11 year activity cycle, and take advantage of one of these rare opportunities to study the sun during its most interesting and dramatic phase. The Appleton Laboratory was a major contributor to the mission, who together with the Mullard Space Sciences Laboratory (MSSL) of University College London, and the Lockheed Missile and Space Company (LMSC) Research Laboratory at Palo Alto, California, were responsible for the conception, design, construction and testing of the X-ray Polychromator, one of the seven experiments carried by the satellite.

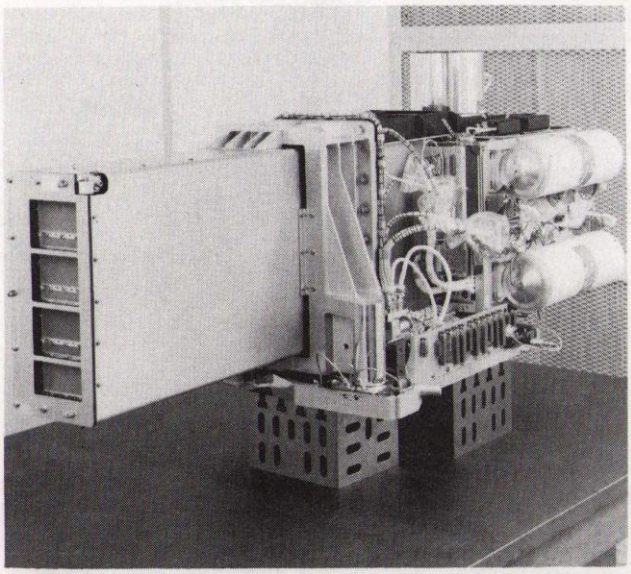
Solar Flares

Activity on the sun is apparent to the casual ground based observer by the presence of sun spots. These quiet looking features are associated

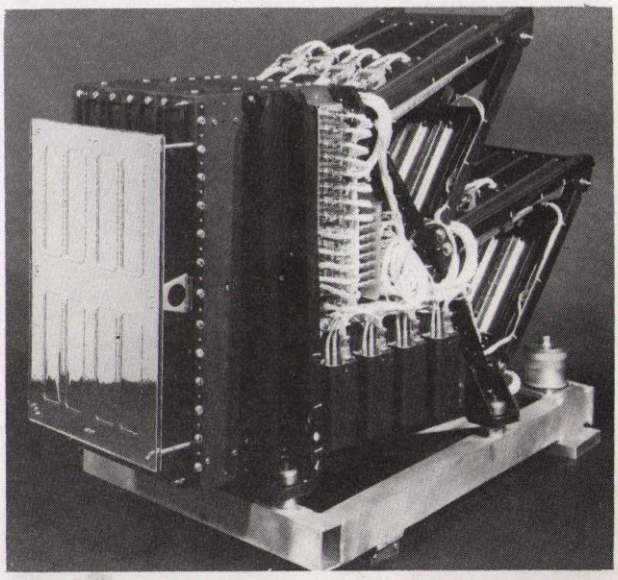
(cont. p.2.)



Schematic Diagram of Solar Maximum Mission Satellite showing the positions of the two Spectrometers which make up the X-ray Polychromator.



The Flat Crystal Spectrometer during assembly.



The Bent Crystal Spectrometer during alignment at the Mullard Space Sciences Laboratory.

SMM

with centres of activity, termed active regions, which are the locations of some of the most spectacular processes occurring in the solar system, namely *Solar flares*. These explosive events occur throughout the solar cycle but are very much more common during the maximum, at which time a few flares per day over the full solar disc may be visible. Flares occur when the magnetic energy stored in the outer layers of the sun, over a period of years, is dramatically and violently released in a matter of minutes. The energy output of a single flare can be as much as 10^{32}erg, and is released in the form of particles streaming into interplanetary space, and as a radiation blast covering a wide spectral range from gamma rays to radio wavelengths. The event is often marked by a towering plasma plume arching over the solar disc. Flares and active regions are very obvious in the X-ray region of the spectrum, where their flux is high and they are seen against the low X-ray background illumination of the quiet areas of the sun. However, in order to observe in X-rays it is necessary to put instruments above the screening effect of the earth's atmosphere. If these instruments are to carry out detailed studies in a thorough manner then a long observing time is required and this dictates the use of such satellites.

The X-ray Polychromator

Significant spectral lines from active regions and flares of the seven most abundant elements on the sun (excluding hydrogen and helium) are present in the X-ray band from 1.4 to 22.4. Angstroms (units of 10^{-8} cms) From these lines it is possible to deduce the temperature and density of the emitting plasma, and from measurements of line shapes and shifts the velocities of bulk plasma motions may be established. The X-ray Polychromator uses this spectral interval to investigate the production of flare plasma in the 1.5 to 50 million degree temperature range. It employs two X-ray spectrometer systems, one using large flat crystals and the other a novel curved crystal configuration. Together they provide for high spatial, spectral and temporal resolution of active solar features.

Flat Crystal Spectrometer

The flat crystal spectrometer consists of four basic sub-systems, a 12 arc second grid collimator to define a narrow field of view, a raster system to enable this field of view to be scanned over a 7 x 7 arc minute area of the sun, a bank of seven, Bragg reflection, X-ray analysing crystals and a detector pack of seven proportional counters with their associated gas supply systems, to detect the wavelength selected X-rays, reflected from the crystals.

The crystals range in size from 200 x 55 mm to 170 to 15 mm and each is chosen to cover a particular wavelength interval within the 1.4 to 22.4 Angstrom band. Two of the crystals, potassium acid phthalate and ammonium dihydrogen phosphate were grown from solution, two were germanium slices cut from a block which was "pulled" from a melt by means of a seed crystal, and the remaining three cut from naturally occurring stones, two of quartz and one of beryl. The beryl crystal proved the most difficult to obtain and a world wide search was required before a suitable stone was eventually found by a gem prospector in Brazil. All the crystals are mounted on a common shaft so that all seven channels may be scanned in wavelength simultaneously. Crystal evaluation, surface preparation and mounting in flight holders was carried out at Appleton Laboratory and final calibration, by the National Bureau of Standards at Washington DC.

The Spectrometer detectors are proportional counters of two types. The three short wavelength channels 1.4 to 5.8 Angstroms use sealed beryllium window counters filled with a Xenon - CO mixture. The four long wavelength channels 4.9 to 22.4 Angstroms require large aperture thin polypropylene counters filled with propane. Active propane control and replenishment is necessary to replace gas lost by diffusion through the thin windows. The detectors and their gas systems were supplied by the Mullard Space Sciences Laboratory with major parts of the detector construction being carried out by the radiation detection group at Harwell.

The low volume, low mass raster system using flex pivots driven by a tangent arm, was developed and constructed by the Appleton Laboratory engineering team as were the electronics for the raster and crystal drive systems. The complete flat crystal spectrometer was assembled and aligned at Culham. Environmental testing took place at LMSC, where the engineers were able to shed light on many of the areas likely to be problematical in orbit.

Bent Crystal Spectrometer

The bent crystal spectrometer provides simultaneous coverage of all wavelengths within eight, fixed spectral intervals, with precise time and wavelength resolution. Seven curved germanium crystals are used to disperse onto position sensitive proportional counters, X-rays in the band 1.769 to 1.947 Angstroms.

This covers the important spectral lines of highly ionised iron, present in flare spectra. The eighth crystal also germanium, covers the calcium flare lines in the range 3.166 to 3.231 Angstroms. The 1mm thick crystals were brought to the required curvature, convex to the incoming X-rays from the sun, by being pressed against precision mandrels.

The field of view is defined by a 6 x 6 arc minute collimator, which is of a size sufficient to encompass completely a single active region, ensuring that a flare occurring in that region will be observed - and with a time resolution limited only by the detector electronics. The bent crystal spectrometer detectors are sealed position-sensitive proportional counters with beryllium windows, filled with a Xenon-CO mixture. Except for the crystals which were handled by Appleton Laboratory all other components were supplied by MSSL who also carried out assembly and alignment.

Microprocessor Control

The X-ray Polychromator is controlled by microprocessors, allowing sufficient flexibility for the automatic change of observing programs in response to solar events without ground based intervention. The digital control data handling systems and power system were the responsibility of the Lockheed Missile and Space Company. A vital component of the SMM operations is rapid data acquisition and reduction from all seven of the powerful and sophisticated instruments on board. For this reason the data reception centre at the Goddard Space Flight Centre, Washington DC., also supports the experiment operations facility, where each of the seven instruments is supported by one or more minicomputers.

New Era

The launch of the Solar Maximum Mission marks the beginning of a new era in solar physics. For the first time the sun is to be studied with a wide range of sophisticated instruments in a coherent manner. The inclusion of the X-ray Polychromator in this assemblage is an achievement of which we should be justifiably proud.

We thank Barry Kent for the information contained in this article.

Special Lecture

Dr R H Thomas, who will be remembered by many for his work in radiation health physics in the early Nimrod period, will be visiting the Laboratory on 10 March. While on site, he will give a talk about his work as Assistant for Health and Safety at Lawrence Berkeley Laboratory (See Internal Events).

INTERNAL Events

HEP SEMINARS
R61 CONFERENCE ROOM - 1100hrs

27 Feb: Prof R Bausch/Julich
"Non-linear Relaxation Processes"

4 March: R C Moore/Manchester
"Pion Structure Function and Drell-Yan Processes"

5 March: Dr J K Davies/Oxford
Title to be announced

12 March: Frank Close/RL
"QCD Pertubation Theory for Confined Quarks and Gluons"

NIMROD LECTURES
LECTURE THEATRE - 1400hrs

25 Feb: Dr J Ellis/CERN
"Grand Unified Theories"

3 March: J Kuti/CERN
"The Early Universe"

SPECIAL LECTURE
CONFERENCE ROOM R61 - 1415hrs

10 March: Dr R H Thomas/
Lawrence Berkeley Lab
"Accelerator Radiation and Health Physics"

COMPUTING SEMINARS
COLLOQUIUM - ATLAS CENTRE - 1400hrs

26 Feb: J M Rushby/Newcastle
"Operating System Security"
(This lecture will be held in R61 Conf.Rm)

11 March: G G Scarrott/ICL
"The Role of the Research and Advanced Development Centre at ICL"

Training

COURSES

SRC

Course III part 1 due to take place June 30-July 4 will now be held between 23-27 June.

UNIVERSITY OF SHEFFIELD
Dept of Mechanical Engineering
24-28 March: "Basic Strain Gauge Application & Analysis"

UNIVERSITY OF SOUTHAMPTON
Institute of Sound & Vibration Research
14-18 April: "Application of Time Series Analysis

Dept of Electronics
26-28 March: "Theory and Practice of Microprocessors"

24-28 March: "Microprocessor Engineering"

26-28 March: "Microprocessor Development Techniques"

CONFERENCES

UNIVERSITY OF SOUTHAMPTON

7-11 July: "Recent Advances in Structural Dynamics"

For further information please contact TRAINING SECTION R20 Ext 6285/266.

TV Computing

The Open University is offering a new course on computer based information systems, designed in response to the recent impact of data bases in data processing.

These may be of general interest to Laboratory Staff, and are to be relayed on BBC2 at 11am on Feb 10, March 9, April 13, May 11, June 8, July 13, Aug 10 and Sept 7, with each being repeated.

Library Notice

New Arrival

The R61 Library has a new reader printer which reproduces both film and fiche. Demonstrations are available - ask any of the Library Staff.

OVERSEAS Visits

A Astbury to CERN from 24-28 Feb to work on Prop 204.
J W Burren to Pisa from 24-28 Feb to attend STELLA steering committee.
J R Barlow to DESY from 24 Feb-3 March to work on TASSO.
J B Forsyth to ILL from 24-27 Feb to attend meeting instrument sub-committee.
M Edwards to CERN from 25 Feb-1 March to attend meeting of NA9.
G R Martin and C Chessum to CERN from 25 Feb-7 March to work on project 200.
M N Atkinson to CERN from 25 Feb-1 March to carry out inventory and equipment check on WA57.
T Adams to CERN from 25-29 Feb to carry out repairs on RMS Cyl Chamber.
K Paler to Paris from 28-29 Feb for collaboration meeting on WA26.
W M Evans to CERN from 5-15 March for shift running on R807.
A Astbury to CERN and Paris from 9-14 March to work on expt 204 and attend ECFA meeting.
R G Roberts and C J Maxwell to CERN and Les Arcs from 9-18 March to attend Rencontre du Moriond and visit CERN.
D H Saxon to DESY and Les Arcs from 10-21 March to attend Rencontre du Moriond and work on TASSO.

Film Badge Notice

Period 3 commenced on Monday, 25 February. Colour Strip BROWN. Please check that you are wearing the correct film and all old ones are returned.

Trade Exhibition

There will be an exhibition by Avica Equipment Ltd of vacuum vessels and bellows in Conference Room 5, Building R20, from 1000 to 1600hrs on Thursday, 6 March.

Missing

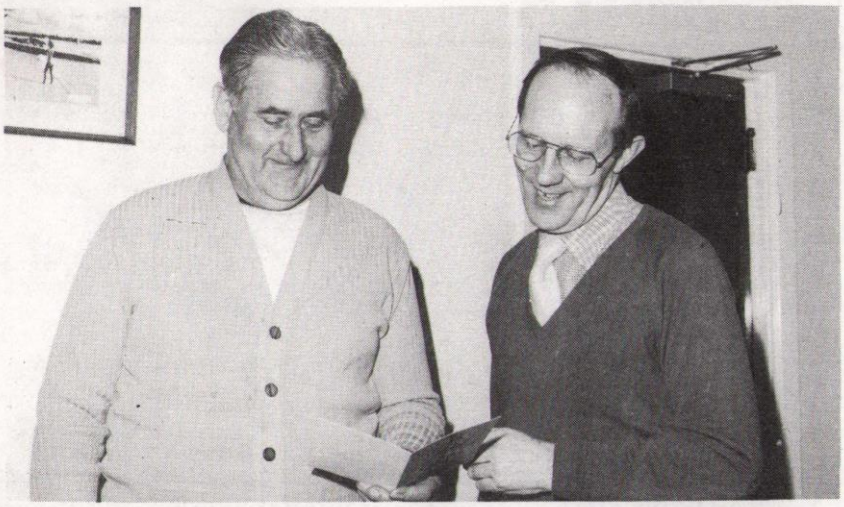
Multimeter, Serial No 90822041 is missing from R2 G2. Anyone knowing of its whereabouts please contact D David, Ext 388/6230.

Also absent from home is Fan Blower, AERE No 5609. Pat Campbell on Ext 570 would like to know where it is.

Leo Hobbis

On Friday, February 8, Leo Hobbis left the Laboratory for his three year period of attachment as Head of Science Division in Central Office. At an informal gathering in R20, members of the Neutron Division presented Leo with various items to mark the occasion including a desk tidy and blotter, a commemorative scroll (suitably inscribed!), an arrangement of photographs prepared by Francis Childs and, last but not least, a T shirt inscribed "The English have style but Kiwis have polish", the latter written over a picture of a tin of shoe polish of well known brand. It was explained that, since he was moving to a temporary appointment, on his return Leo would have to give these items back! We wish him success in his new work and look forward to his return.

Rare Craftsman



"A man of rare experience" was the tribute paid to Charles Gascoigne, at a ceremony to mark his retirement on Friday, 8 February. "For 18 years we have benefited from a craftsman of high repute", said Derek Moore, who was making the presentation. "He has worked quietly, efficiently and thoughtfully. The number and quality of his award winning suggestions typifies how much the Laboratory has gained from this well trained craftsman."

Charles Gascoigne's training had started in 1928 as an apprentice with William Parry, and continued in the RAF where he rose to the rank of Sergeant Machine Tool Setter. In 1946 he joined Smart & Brown as a universal grinder, moved to Rolls Royce in 1953 and to English Electric in 1960. He joined the Rutherford Laboratory's R9 Workshop in 1962 as a universal miller/grinder.

"The work he has produced, together with a thorough application of his skills, makes me wonder how we shall replace him", said Derek. "We all wish him and his wife, Kathleen, also a well respected member of the Laboratory, a very happy retirement, and we wish them a very pleasant mini-world tour, they are both planning."

Charlie replied that he was surprised and delighted with the presentation. He remembered well, he joked, starting work on a Wednesday and by Friday had decided that he didn't like it - unfortunately he had never been out of it! (However, since it transpires that he had never been sick or had a day off (except holidays) in all his time at the Laboratory - this cannot be taken too seriously.) "I wish R9 all the luck it deserves, and God Bless you all," he concluded.

Lunchtime Music

Lecture Theatre - 1230hrs
Wednesday, 27 February

"LIVE IN COOK COUNTY JAIL" - B B KING

B B King could be called the only 'Superstar' of blues, often playing at such venues as Caesar's Palace. However, on this album he plays at the notorious Cook County Jail in Chicago. B B was playing there as a tribute to Winston E Moore, the Warden, who had made the prison more civilised.

B B King's style of Chicago blues has inspired some of the better white rock bands of recent years.

Folk Club

Our next meeting is on Friday, 7 March, at 8pm in the Restaurant Coffee Lounge, featuring Mandy Morton with Spriguns, a three piece band. Mandy will not only supply the songs sung in her own unique style, but her powerful acoustic guitar work provides the driving force to the band.

Also appearing are the Reading Barbershop Harmony Club who in the last few years have been in the top five of the British Harmony Clubs. They are particularly known for their quartet singing.

A bar and food are provided for your enjoyment. Everyone welcome.

Tickets are £1.40 at the door or £1.20 in advance from:
John Ellis Ex 6369/494
Alan Hodges Ex 6323

Indoor Sportsday

The 1980 Indoor Sports Day is being held at the Oasis Sports Centre in Swindon on Friday the 18th April followed by a Supper/Disco at Central Office. Tickets for the social will cost £1.50 payable before the 27th March. There will be no tickets available on the night.

The events will be as last year and are as follows:-

Badminton: Mens Pairs and Mixed Pairs
Contact Peter Craske Ext 232

Volleyball: Mixed teams of eight
Contact J Rice Ext 6302

Table Tennis: Teams of 3
Contact John Varley Ext 6302

Squash: Mixed teams of 3
Contact John Rice Ext 6302

Chess: Individual and Bridge Pairs
Contact Peter Craske Ext 232

Darts: Teams of five
Contact Ian Forster Ext 6300

Cribbage: Pairs
Contact Tudor Morgan Ext 563

All Atlas people should contact Lorna Claringbold Ext 6325.

Competitors are reminded that they are restricted to entry in one event only.

Coffee at Cosener's

All wives of Rutherford and Appleton Laboratories personnel, are cordially invited to a Coffee Morning, to be held at the Cosener's House, Abingdon, on Tuesday, 4 March, from 10.30am to noon.

Children are very welcome and orange juice and TV provided.

We look forward to seeing old friends and meeting new ones.

If you want to know more, please ring Gillian Litt (Abingdon 26009), or Dorothy Gibson (Abingdon 25250)

Thanks

The editor has received the following letter from Sid Wallace.

"I would like to thank all those who contributed to my farewell gifts and would like to apologise to those who, for one reason or another, I was unable to see. My best wishes to all at the Rutherford and my grateful thanks once more."

RUTHERFORD LABORATORY BULLETIN

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Deadline for Insertions
10.00 hrs Monday 10 March

Published by the Scientific Administration Group

EXTERNAL Events JEAN

ASTROPHYSICS SEMINARS
F5 CONF.RM - CULHAM - 1400hrs

12 March: Dr A Willis/UCL
"IUE Observations of Cosmic X-Ray Sources and Wolf-Rayet Stars"

19 March: Prof J Houghton FRS/AL

THEO.PHYS.SEMINARS
T.P.CONF.RM. B424.4 - AERE - 1400hrs

26 Feb: Dr M W Finnis/AERE
"Energy Systems Analysis for IEA"

4 March: Dr C P Buckley/UMIST
"Non-Linear Viscoelasticity of Polymeric Solids: Its Phenomenological Description and Physical Origin"

NPD COLLOQUIUM
H8 CONF.RM - AERE - 1530hrs

28 Feb: Dr D Sciama/Oxford
"Black Hole Explosions"

6 March: Prof P Sigmund/Odense U.
"Radiation Damage"

THEOR.PHYS.SEMINARS
CLARENDON LAB - OXFORD - 1615hrs

28 Feb: Prof R Bausch/Julich
"Theory of Dynamic Critical Phenomena"

6 March: Prof F S Levin/Brown & Bonn
"Many Body Scattering Phenomena, and the Structure of Atoms and Molecules

13 March: Prof D Lichtenberg/Indiana
"Quark Bound-state Phenomenology"

NUCLEAR STRUCTURE SEMINARS
NPD LECTURE TH. - OXFORD - 1430hrs

25 Feb: Dr A Shotter/Edinburgh
"The Decay of the Giant Quadrupole Resonance in Heavy Nuclei"

10 March: Dr L K Fifield/Oxford
"Experiments Related to the Search for Neutral Weak Current Effects in Nuclei"

COMPUTING SEMINARS
NPD LECTURE TH. - OXFORD - 1630hrs

28 Feb: Mr P Redstone/Logica
"A User's Experience of Using the DAP System"

6 March: Dr M Duff/UCL
"Special Processors for Image Processing"

13 March: Prof J Alty/Liverpool
"Software and Evolving Technology"

ELEM.PART.PHYS.SEMINARS
NPD LECTURE TH. - OXFORD - 1430hrs

28 Feb: Prof D H Perkins/Oxford
"Experiments on Proton Stability Past, Present and Future"

6 March: Dr Minh Duong-Van/LASL
"Neutral Current Experiments and the Rare Decays of Leptons"

PHYSICS COLLOQUIA
CLARENDON LAB - OXFORD - 1615hrs

29 Feb: Prof D J Bradley FRS/Imperial
"Picosecond Laser Physics and Applications"

7 March: Prof D K Scott/Mich. State
"The Pursuit of the Exotic in High Energy Nuclear Collisions"

ELEM.PART.THEO.SEMINARS
NPD LECTURE TH. - OXFORD - 1200hrs

27 Feb: J Ellis/CERN
"Recent Developments in Grand Unification"

PHYSICS COLLOQUIA
BRISTOL - 1700hrs

25 Feb: Prof R H Ottewill/Bristol
"Studies of Electromagnetic Radiation of Structure in Colloidal Dispersions"

3 March: Dr J Wilson/Bristol
"Systematics of the Breakdown of Mott Insulation in Binary Transition Metal Compounds - Revisited"

10 March: Dr V J Smith/Bristol
"Experiments in the Hyperon Beam at CERN"

PARTICLE PHYSICS SEMINARS
BIRMINGHAM - 1615hrs

29 Feb: Prof A Clegg/Lancaster
"Vector Mesons and Jets in Hadronic Content of the Pure Photon"

7 March: Dr J A Wilson/Birmingham
"New Results on J/ψ Production by $\pi^{\pm}$, $K^{\pm}$, $\bar{p}$ and p at 40GeV/c

14 March: Dr B R Webber/Cambridge
"Topics in QCD Spectroscopy and Multiquark States"

ELEM.PART.PHYS.SEMINARS
UCL - LONDON - 1415hrs

5 March: F Schremp/Durham
"QCD at Low Q^2 - A Correspondence Relation for Deep Inelastic Structure Functions"

12 March: M Kugler/Weizmann Inst
Title to be announced

ELEM.PART.PHYS.SEMINARS
DAMTP - CAMBRIDGE - 1500hrs

29 Feb: B R Webber/Cambridge
"Observability of QCD Effect in Jets"

7 March: P W Higgs/Edinburgh
Title to be announced

14 March: R Hughes/Oxford
"Classical Approach to Asymptotic Freedom"

HEP SEMINARS
CAVENDISH LAB - CAMBRIDGE - 1500hrs

27 Feb: Dr F Loebinger/Manchester
"Results from the JADE Experiment at PETRA"

5 March: Dr I Skillicorn/Glasgow
"Vector Meson Production by 20-70GeV Protons"

12 March: Dr M Green/QMC
Title to be announced

THEOR.PHYS.SEMINARS
MANCHESTER - 1630hrs

27 Feb: Prof N H March/Oxford
"Electron Liquids and Electron Crystals"

5 March: Dr B L Gyorffy/Bristol
"Tunnelling States in Metallic Glasses"

12 March: Dr D Sherrington/Imperial
"Elementary Excitations of a Disordered Magnet"

HEP SEMINARS
MANCHESTER - 1400hrs

26 Feb: Dr R G Roberts/RL
"QCD and Deep Inelastic Scattering - Confrontatio with Data"

4 March: Dr A Hey/Southampton
"Are there Exotic Hadron States"

11 March: Dr R Barlow/Oxford
"Recent Results from TAS

SHEP SEMINARS
SOUTHAMPTON - 1430hrs

29 Feb: D Sutherland/Glasgow
"Some Viewpoints on Problems in Grand Unification"

7 March: G Jones/Imperial
"η' Width and Quark Cha

14 March: C T Sachrajda/Southampt
"Topics in Pertubative